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February 1, 2002

BY ELECTRONIC FILING

Ms. Magalie R. Salas
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Written Ex Parte Presentation
ET Docket No. 98-153

Dear Ms. Salas:

On behalf of my client QUALCOMM Incorporated ("QUALCOMM"), attached for filing is a written ex parte presentation in the above-referenced proceeding.

Sincerely yours,

Dean R. Brenner
Attorney for QUALCOMM Incorporated

cc: Edward Thomas
Bruce Franca
Julius Knapp
Michael Marcus
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Summary

QUALCOMM submits this written ex parte presentation to respond to a January 23, 2002 filing by XtremeSpectrum which takes issue with assumptions used by QUALCOMM in its testing of the harmful interference from a ultra wideband ("UWB") device to a wireless phone using QUALCOMM's E911 technology (known as gpsOne™).[1] A fundamental issue before the Commission in this proceeding is whether safe, reliable, and robust E911 service can be provided in the face of UWB emissions. Despite XtremeSpectrum's mistaken arguments against QUALCOMM's assumptions, the fact remains that QUALCOMM's test results have demonstrated that E911 service will suffer serious degradation consisting of dropped calls, blocked calls, and inaccurate positioning for wireless callers to 911 centers because of UWB emissions which raise the noise floor of the gpsOne™ receiver.

The relevant measurement of the impairment to E911 service from a UWB device is not, as XtremeSpectrum would have it, merely the distance at which the gpsOne receiver fails to meet the Commission's E911 accuracy rules 50% of the time. Rather, the relevant measurement of the extent of the impairment is the overall signal-to-noise plus interference level (C/N+I) of the gpsOne receiver operating in the face of a UWB device as compared to that level of a gpsOne receiver operating without any nearby UWB device. As shown herein, analyzing that measurement, which is the true determinant of the harm to E911 service from a UWB device, compels the conclusion that the emissions from a single UWB device will substantially impair E911 service.

To protect a gpsOne receiver from this harmful interference from even a single UWB device requires an emissions mask of 35 dB across all bands. XtremeSpectrum's submission pretends that the only challenge to E911 service is interference in the GPS band. To the contrary, E911 service requires both a reliable communications link (the wireless call to 911) plus an unimpeded GPS signal. For this reason, the emissions mask must be 35 dB below the current Part 15 Class B level across both the GPS, the PCS and cellular bands. And, the emissions mask must provide an additional margin to protect against aggregate interference.

XtremeSpectrum's quarrels with QUALCOMM's assumptions are totally unfounded and miss the critical point. QUALCOMM's testing was designed to prove scientifically that a UWB device will cause harmful interference to a gpsOne receiver. As a result, QUALCOMM assumed a GPS signal which is stronger than the GPS signal actually received 95% of the time, as shown in

[1] See QUALCOMM Incorporated Ex Parte Filing (January 11, 2002); XtremeSpectrum Ex Parte Filing (January 23, 2002).

Figure 3-6 of QUALCOMM's report. Thus, in realistic scenarios encountered every day by wireless callers calling 911 from places where the GPS signal is relatively weak, the harmful interference from a UWB device will be much worse than shown in the QUALCOMM report, and this is true even at much reduced power levels of the UWB device. Indeed, while QUALCOMM's tests used a GPS signal of –136 dBm, the worldwide standard for E911 phones using the CDMA air interface requires performance with a significantly weaker GPS signal of -147 dBm. With that weaker GPS signal, which is a very realistic scenario, E911 service will be eroded to a substantial extent by UWB devices, and the public's safety will suffer as a result.

Finally, at a recent meeting with the staff of the Office of Engineering and Technology (OET), a staff member gave QUALCOMM a graph showing the distance at which the gpsOne receiver would have a position error of greater than 50 meters 50% of the time with the UWB device operating at several assumed power levels lower than Part 15 levels. As already shown, QUALCOMM submits that the measurement displayed in such a graph is not the appropriate one to capture the degradation to E911 service that will occur as a result of a UWB device and is not useful for the design of an emission mask for UWB devices to ensure that the American public enjoys the protection of the best possible E911 service.

The Commission should ensure that E911 service is not any less reliable, robust, or safe as a result of UWB emissions. That is the only objective that would be consistent with the Commission's repeated emphasis on E911 deployment to enhance public safety and homeland security. To achieve that objective, the staff should examine the overall diminishment in the signal-to-noise plus interference level (C / N+I) suffered by a gpsOne receiver operating in the face of a UWB device, as compared to the level of a gpsOne receiver operating by itself (the reference receiver in QUALCOMM's test). The strength of the GPS signal in QUALCOMM's test must also be taken into account in weighing the diminishment that will occur in realistic scenarios. As shown herein, such diminishment will be significant unless UWB emissions are limited to a level 35 dB below the current Part 15 level in the PCS, cellular, and GPS bands, a limitation that will protect gpsOne receivers to within six feet of a UWB device. The same protection is needed up to 6 GHz to protect DoD systems and critical aviation services.

1. Response to XtremeSpectrum's Comments

1.1 XtremeSpectrum Claim: QUALCOMM used unrealistically high emissions levels;

QUALCOMM Response: The Part 15 level is a common reference point, and all proposals for lower levels can be weighed. But, when analyzing a lower level of emissions to conduct a more realistic analysis, the analysis must also factor in a much weaker GPS signal. XtremeSpectrum's calculations are distorted because they changed only one variable, the power level, while assuming a GPS signal that is stronger than the signal actually received 95% of the time.

In its filing, XtremeSpectrum claimed that QUALCOMM made the wrong assumption by using Part 15 levels for the UWB emissions in calculating the UWB-GPS separation distances. QUALCOMM does not believe this is in any way an incorrect assumption for its scientific testing. The Part 15 limits were used simply to avoid confusion with the multitude of emissions proposals[2] under way. By choosing the Part 15 level of -41.3dBm/MHz as the reference case, one can easily determine the amount of further attenuation required in the UWB emissions at various lower power levels as well.

In fact, this is the approach that has been taken by the NTIA in several of their filings[3] with the FCC. The NTIA has always used the Part 15 level as a reference and then decided how much further attenuation is required from those levels. Indeed, while XtremeSpectrum claims that no one is proposing that UWB devices be permitted to operate at the Part 15 level, in a recent ex parte filing, Time Domain claimed (erroneously) that wireless phones would not suffer any interference from a UWB device operating at the Part 15 level within one foot.[4] In fact, in January 29, 2002 ex parte filing, Time Domain proposed that UWB devices operate at Part 15 limit below 960 MHz, including the cellular band. Thus, while the Part 15 level was selected because it is the easiest benchmark against which all proposals can be compared, it also has particular significance in this proceeding.

By using the Part 15 levels as a baseline, one can easily come up with the appropriate new emissions limits, which is what the Commission is in fact trying to do at the moment. QUALCOMM believes that until the new emissions limits

[2] XtremeSpectrum proposed 35dB reduction in September 10 ,2001 filing, XtremeSpectrum proposed 18dB reduction in April 25, 2001 filing, 12dB reduction proposed in the NPRM

[3] NTIA Publications 01-47, 01-45

[4] Time Domain Ex Parte Filing (January 17, 2002).

have been finalized, it is more appropriate to continue using Part 15 levels in all analysis since it avoids confusing the reader with the different proposals under way.

XtremeSpectrum used the wrong thresholds in developing Table 1 (see XtremeSpectrum Ex Parte at Table 1, Pg. 2). At these thresholds E911 calls will fail to meet the FCC mandate 50% of the time. The appropriate measure is the signal-to-noise plus interference ratio (C/N+I). XtremeSpectrum should have used the C/(N+I) metric to calculate the required protection distance. In addition, these tests were conducted under a controlled environment with a relatively strong satellite signal. QUALCOMM did so to isolate the causes of interference, that is to exclude reception problems that may occur in part because of the weaker signal and in part because of the noise from the UWB device. This analysis was fully appropriate from a scientific standpoint, but did understate the harm gpsOne receivers will suffer in the real world from UWB devices. The results reported by QUALCOMM should be used with C=–147 dBm, the level used in the worldwide standard for E911 phones using CDMA, rather than the –136 dBm used in QUALCOMM's testing, to calculate the protection distance required to guarantee the necessary C/(N+I).

In the real world, a gpsOne receiver will not be able to deliver a position within 50 meters 50% of the time when it is within centimeters of a UWB device even if the device is operating at 34 dB lower than Part 15 and certainly not when it is at 21 dB below Part 15. The protection distance at 35 dB below Part 15 is only 6 feet. There is no scientific basis to change only one variable (power level) as XtremeSpectrum does, and the figures in XtremeSpectrum's Table 1 are distorted for this reason.

1.2 XtremeSpectrum Claim: QUALCOMM used an unreasonable environment.

QUALCOMM Response: QUALCOMM's study was designed to isolate the interference caused by a UWB device and to eliminate other possible causes of interference.

XtremeSpectrum takes issue with QUALCOMM's testing because QUALCOMM had the GPS receiver alone with the UWB transmitter. XtremeSpectrum claims that in the real world, the GPS receiver will not be isolated with a single UWB transmitter but will be in the presence of other sources of RFI. XtremeSpectrum is criticizing QUALCOMM for presenting results that are too scientifically valid because QUALCOMM took care to isolate the cause of the interference and to eliminate all causes other than the UWB device. This claim is absurd on its face. XtremeSpectrum is disregarding the goals of any scientific study:

1. Isolate variables under test
2. Eliminate other variables
3. Obtain repeatable results

The only way these goals can be met is by performing tests in a controlled environment, and it would be grossly inappropriate for the Commission to discount QUALCOMM's test on the basis suggested by XtremeSpectrum. QUALCOMM's GPS/UWB test was performed keeping the above goals in mind. The tests were done in a conducted environment to specifically avoid any external interference so that the impact of the UWB emissions, and UWB emissions only, could be scientifically assessed.

There is no question that before UWB devices are authorized, there should be additional tests of UWB devices to determine how they will operate in a host of realistic environments. QUALCOMM's testing of UWB devices has necessarily been quite limited because major UWB companies have refused to loan or sell QUALCOMM any device. So, with that limitation, at this point in time, the threshold question to answer through testing is to what extent will gpsOne receivers and other wireless phones suffer due to UWB emissions alone. There is no scientifically valid way to answer that question other than the controlled environment used by QUALCOMM in its tests.[5]

XtremeSpectrum goes on to claim that QUALCOMM's method of "wiring in" the UWB interference source omitted presence of other nearby sources of interference. Ideally, it would be desirable to perform radiated tests with several actual UWB transmitters and consumer electronic devices in the vicinity of the GPS receiver. But, even if other sources contribute to the noise floor, which we do not agree with, how do we separate the effects of each source? Again, the only scientifically valid way to determine whether and to what extent UWB devices will cause harmful interference is to exclude all other sources of interference.

In fact, to follow XtremeSpectrum's recommendation would pose great difficulties in obtaining repeatable results and isolating the UWB interference, thereby undermining any conclusions that could be made from the testing. In

[5] This is also why QUALCOMM deliberately chose a clean GPS signal of about -136dBm which is considerably stronger than the required sensitivity of -147dBm. This level allowed QUALCOMM to isolate easily the impact of the UWB device and to obtain repeatable results.

short, to conduct testing in the manner suggested by XtremeSpectrum would leave the Commission unable to determine whether the interference found in the testing was caused by the UWB device or by other factors. QUALCOMM's tests tried to emulate an indoor channel in a controlled environment. QUALCOMM believes that the test performed is representative of some indoor channels and that the test results indeed do isolate the impact of UWB emissions on E911, an impact which is quite harmful to safety of life service.

Indeed, XtremeSpectrum's revised analysis for the relative impact of other RF signals in the environment (XtremeSpectrum Filing at Pg. 3) is entirely speculative. XtremeSpectrum has not produced any test of how a gpsOne receiver performs in the presence of Part 15 devices. In fact, QUALCOMM's testing of gpsOne receivers in indoor environments in which Part 15 devices, such as personal computers, are located has not identified any significant interference problem from such devices.[6] XtremeSpectrum can speculate forever about the impact of other devices, but there is no scientific study that shows any other device having a harmful impact on gpsOne receivers or wireless phones as a UWB device.

In this regard, the Commission has already noted in the Notice of Proposed Rulemaking that "the emissions from UWB transmission systems are considerably different from those of unintentional radiators and conventional Part 15 transmitters."[7] XtremeSpectrum quoted the foregoing words in a January 28, 2002 filing, but yet ignored the same words in criticizing QUALCOMM's tests as unduly controlled.

1.3 XtremeSpectrum Claim: QUALCOMM used unreasonable propagation.

QUALCOMM Response: **This claim is simply wrong. Line-of-sight propagation indoors follows free space.**

XtremeSpectrum asserts, as it has in previous filings, that the propagation model used by QUALCOMM is inaccurate. They claim that ordinary walls and furniture severely attenuate UWB signals. This claim is just wrong.

It is well-established that line-of-sight propagation indoors follows free space. When two peer devices are downloading files or exchanging business cards from one to the other, the two clients are not usually separated by walls, and neither is the victim receiver. They will all be in the same office of meeting room and subject to harmful interference. This is a very realistic scenario for the type of

[6] In a separate companion filing, QUALCOMM is submitting such test results.
[7] Notice of Proposed Rulemaking, 15 FCC Rcd 12086, para. 40 (2000).

peer-to-peer communication between or among UWB devices for which XtremeSpectrum is seeking authorization.

The Intel Report[8] separates the distance between the UWB transmitter and the victim receiver into two regions, each of which has a different path loss exponent. For distances less than 10 meters, the free space path loss model is used.

1.4 XtremeSpectrum claim: The impact on the noise floor needs to be adjusted.

QUALCOMM response: **No such adjustment is necessary or appropriate. XtremeSpectrum does not understand QUALCOMM's measurements and procedures.**

XtremeSpectrum takes issue with the way the degradation in noise figure was calculated, claiming that the empirical results show that the theoretical analysis was wrong because the theoretical model predicted that the noise figure degraded by 0.5 to 1 dB too much. This claim is just wrong.

Apparently, XtremeSpectrum did not understand how the theoretical and empirical results were obtained. They attributed the differences between the theoretical and empirical results as "lack of real-world RFI environment being included in the analysis." QUALCOMM would like to explain some of the measurement procedures and put the results in perspective. The theoretical model assumes a certain noise figure or receiver noise floor (N) and a fixed interference-to-noise ratio (I/N) in calculating the noise figure degradation. The degradation is then calculated as 10log(1+I/N) dB. The only assumption made here is the noise figure of the victim receiver. No propagation law exponent or any other assumptions are used.

In the case of the empirical results, the degradation in noise figure is calculated by comparing the test phone C/No to the reference phone C/No. This C/No value is statistical in nature and is a function of satellite geometry at the time the measurements were made. For a specific PRF and each UWB power level, M samples were collected. Each sample can contain several visible satellites, sometimes as many as 10 satellites, each having a different C/No. For each UWB power level, the cumulative distribution of all the C/No samples was obtained. If there were 10 satellites visible in each of the M samples, then there would be a total of 10M different C/No points. The plots in the QUALCOMM report showed the noise figure degradation as computed from the 95th percentile C/No values. For example, if we use the 99th percentile value, the degradation

[8] Reply Comments of Intel Corporation filed October 27, 2001.

approaches, and sometimes exceeds, the theoretical values. Figure 1-1 shows the degradation of noise figure as a function of UWB power using the 95th and 99th percentile empirical values. Figure 1-2 shows the degradation of noise figure as a function of UWB-GPS separation distance for the 95th and 99th percentile empirical values. These two plots are equivalent to Figure 4-19 and Figure 4-10 respectively, as shown in QUALCOMM's January 11, 2002 filing.

Thus, there is no basis for making any adjustment in the results in QUALCOMM's analysis, contrary to XtremeSpectrum's claims.

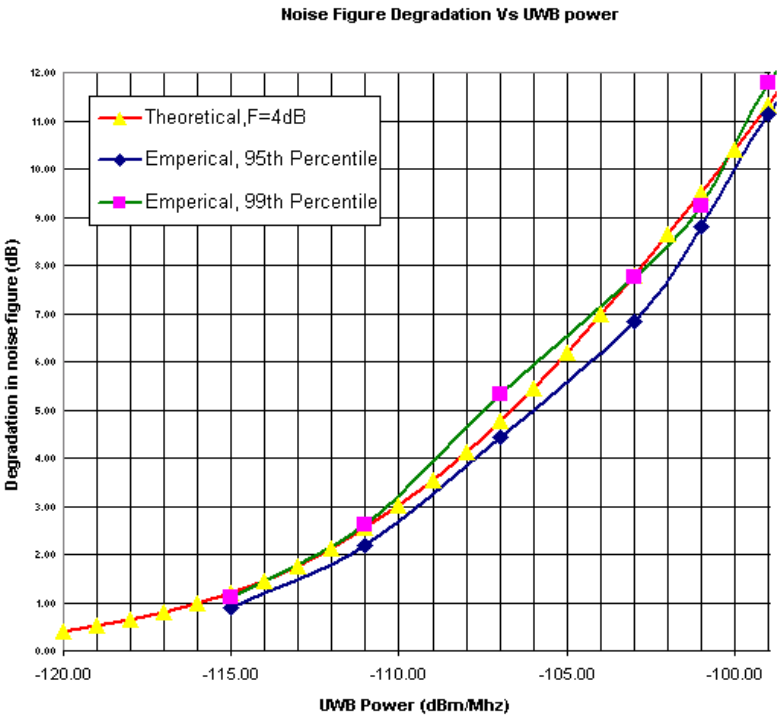

Figure 1-1: Noise Figure Degradation Vs UWB Power

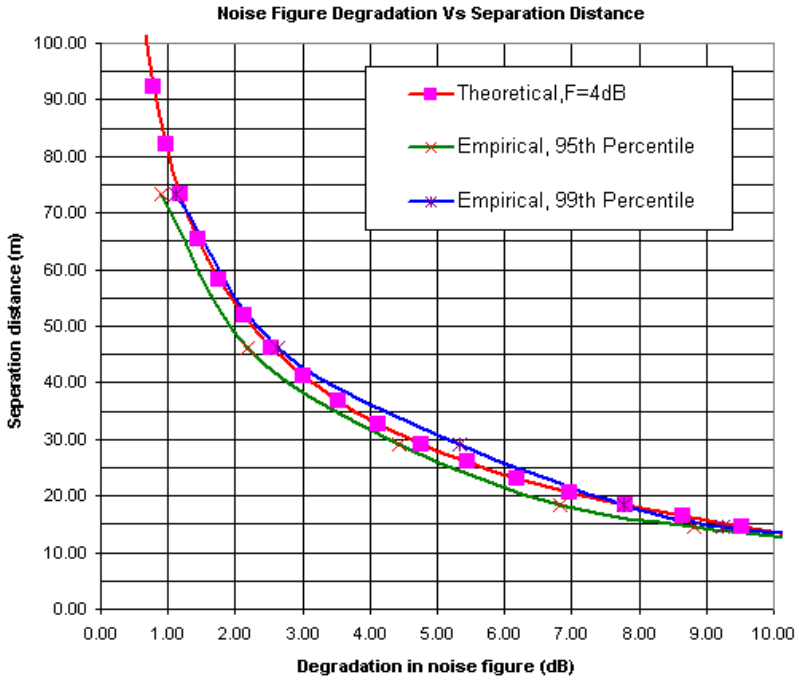

Figure 1-2: Noise Figure Degradation Vs UWB-GPS separation distance

2. The Proper Criterion to Measure the Harmful Interference from a UWB Device to Design an Emissions Mask

At a recent meeting with the staff of the Office of Engineering and Technology, a staff member gave QUALCOMM a graph showing the distance at which the gpsOne receiver would have a position error of greater than 50 meters 50% of the time with the UWB device operating at several assumed power levels lower than Part 15 levels. The measurement displayed in such graph is not the appropriate one to capture the degradation to E911 service that will occur as a result of a UWB device and is not useful for the design of an emission mask for UWB devices to allow the American public to enjoy the full protection of E911 service.

The Commission should ensure that E911 service is not any less reliable, robust, or safe as a result of UWB emissions. That is the only objective that would be consistent with the Commission's repeated emphasis on E911 deployment to enhance public safety and homeland security. To achieve that objective, the staff should examine the overall degradation in the signal-to-noise plus interference level (C/N+I) suffered by a gpsOne receiver operating in the face of a UWB device as compared to the level of a gpsOne receiver operating by itself (the reference receiver in QUALCOMM's test). The strength of the GPS signal in QUALCOMM's test must also be taken into account in weighing the degradation that will occur in realistic scenarios. Such degradation will be significant unless UWB emissions are limited to a level 35 dB below the current Part 15 level in the PCS, cellular, and GPS bands, a limitation that will protect gpsOne receivers to within six feet of a UWB device.

The Commission cannot measure the degradation to E911 service from UWB devices merely by looking at the separation distance at which E911 service fails completely 50% of the time, or 34% of the time for that matter. Since 1996, the Commission has been encouraging the deployment of reliable, safe E911 service, and it would be contrary to that goal to allow UWB devices to degrade the performance of E911 phones. Stated differently, to design an emissions mask based on such separation distances would still leave countless numbers of wireless callers to 911 without reliable E911 service because of UWB emissions, a result which would be squarely at odds with the Commission's seven years of work in the E911 proceeding.

Moreover, in designing an emissions mask, the Commission should be aware that the QUALCOMM test data was collected with excellent satellite geometry. In real indoor environments, satellite measurements will be more challenging because of poor geometric dilution of precision (GDOP) that will degrade the position accuracy. As a result, for reliable E911 service, there has to be much

more protection for the GPS band than a simple graph of separation distances would indicate. The E911 system mandated by the FCC is composed of two components; a measurements component where the GPS sensor collects measurements from the GPS constellation and a communications link component that is responsible for sending the measurements to the server. The server calculates the position and in turn sends the results to the requesting PSAP. Protecting E911 requires protecting both components. It does not do the safety-of-life system any good if the communications link is degraded or not working. Hence, protecting the cellular and the PCS bands is just as important as protecting the GPS band. Using the earlier tests conducted by QULACOMM on PCS phones and invoking the propagation loss at 800 MHz, it can be shown that the cellular band needs as much as 35 dB below Part 15 levels at 6 feet protection distance in order to prevent harmful interference. The same protection is needed up to 6 GHz to protect DoD systems and critical aviation services.

In addition, as already shown herein, Figure 3-6 of QUALCOMM filing dated January 11, 2002 indicates that 95% of the indoor measurements have C / No of 34 dB-Hz or less, and thus in designing an emissions mask, the data shows that the Commission must assume that GPS signal will be significantly weaker. The *Recommended Minimum Performance Specification for IS 801-1 Spread Spectrum Mobile Stations* specifies –147 dBm as the sensitivity of the GPS sensor. When approved, it will be published as Interim Standard 916 (IS-916) and considered the standard for the performance of wireless phones containing position location technology and using the code division multiple access ("CDMA") air interface. This standard is currently being voted on and is considered likely to be adopted next month. The standard, once enacted, will be the worldwide standard governing phones that use QUALCOMM's gpsOne E911 technology, as well as other handset solutions for CDMA phones. Carriers in the United States are already selling these location enabled phones to meet the FCC's E911 mandate. The Commission should protect E911 service to the -147 dBm level of GPS signal which the OET staff's graph failed to do.

Similarly, devices used for safety-of-life applications need RF link margin. Engineers always use margins in any wireless communications or navigation link budgets and we cannot take the risk of developing an out-of-band emission mask without having the appropriate link margins. These margins are used to compensate for degradation in the channel conditions, component-to-component variation and other stochastic phenomena. Time Domain in their filing dated January 17, 2002 (slides 15 and 16) used 10 dB of margin for UWB communication devices. There has to be a link margin for the E911 service which the graph alone would not yield.

In cubical offices, airport waiting areas, hotel lobbies, and the like, there could well be a plethora of UWB devices within close distances. QUALCOMM's test, and any graph based thereon, only showed the interference from a single UWB device. But, there will be aggregate interference, and the Commission should provide a margin for such aggregate interference in designing any emissions mask.

Finally, attached to this document is a set of charts to demonstrate the behavior of C/(No+Io) as a function of the distance between a single UWB device and a GPS receiver at different out-of-band emission levels. Figure 5 is the case of GPS signal C = -136 dBm. At 3 meters protection distance and 21 dB below Part 15 level, the C/(No+Io) = 30 dB-Hz. This should be contrasted with the case of C =-147 dBm in Figure 7 where C/(No+Io) is less than 18 dB-Hz. These graphs show that even a limit of 21 dB below Part 15 would not provide enough protection when the receiver is working near the sensitivity levels set by the standards. QUALCOMM's calculations show that a GPS enabled wireless device needs at least 35 dB below Part 15 limits protection when operating near –147 dBm.

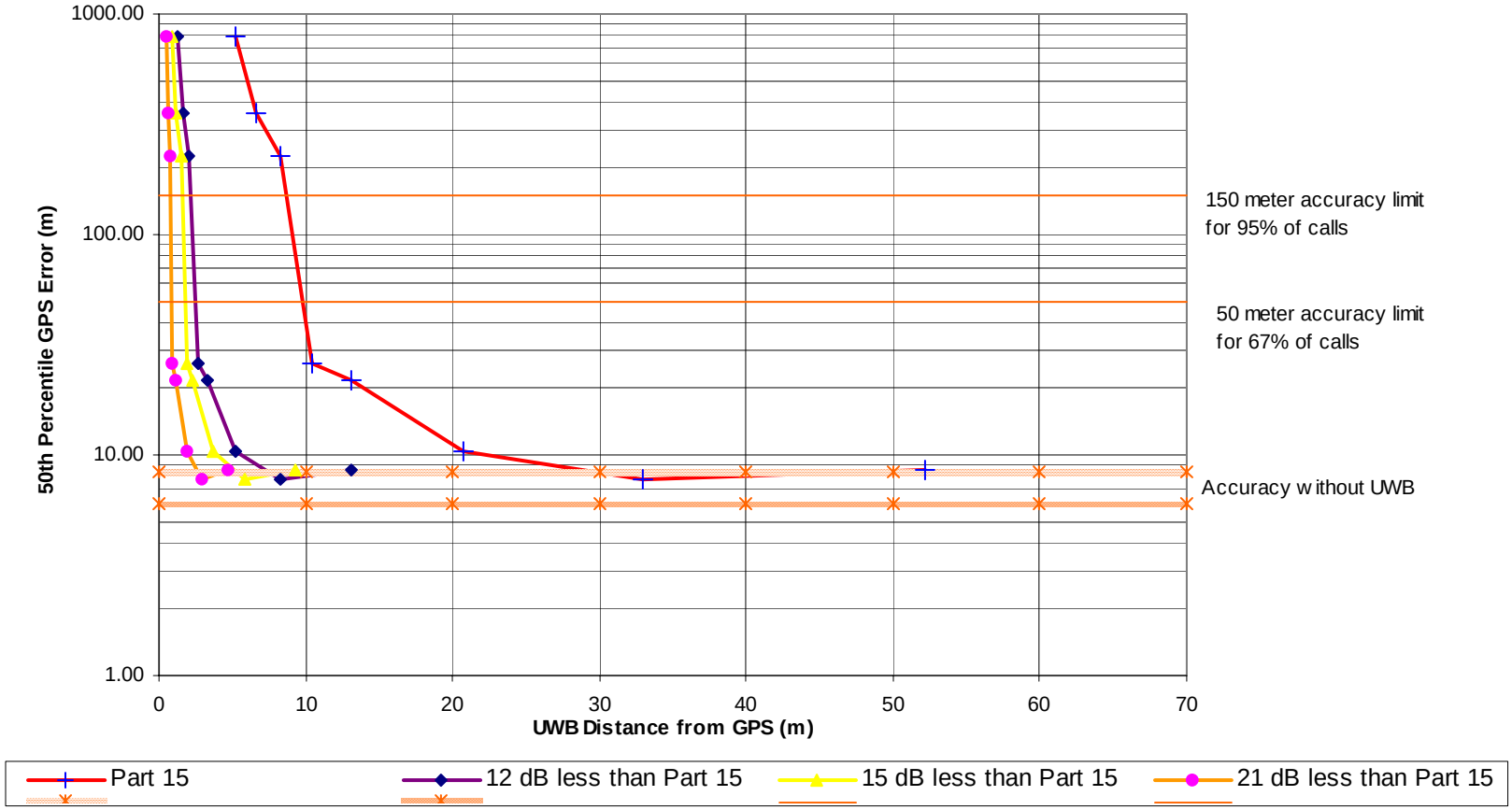

Figure 3: 50th percentile QUALCOMM data with different UWB limits (same figure handed out by OET staff on January 23)

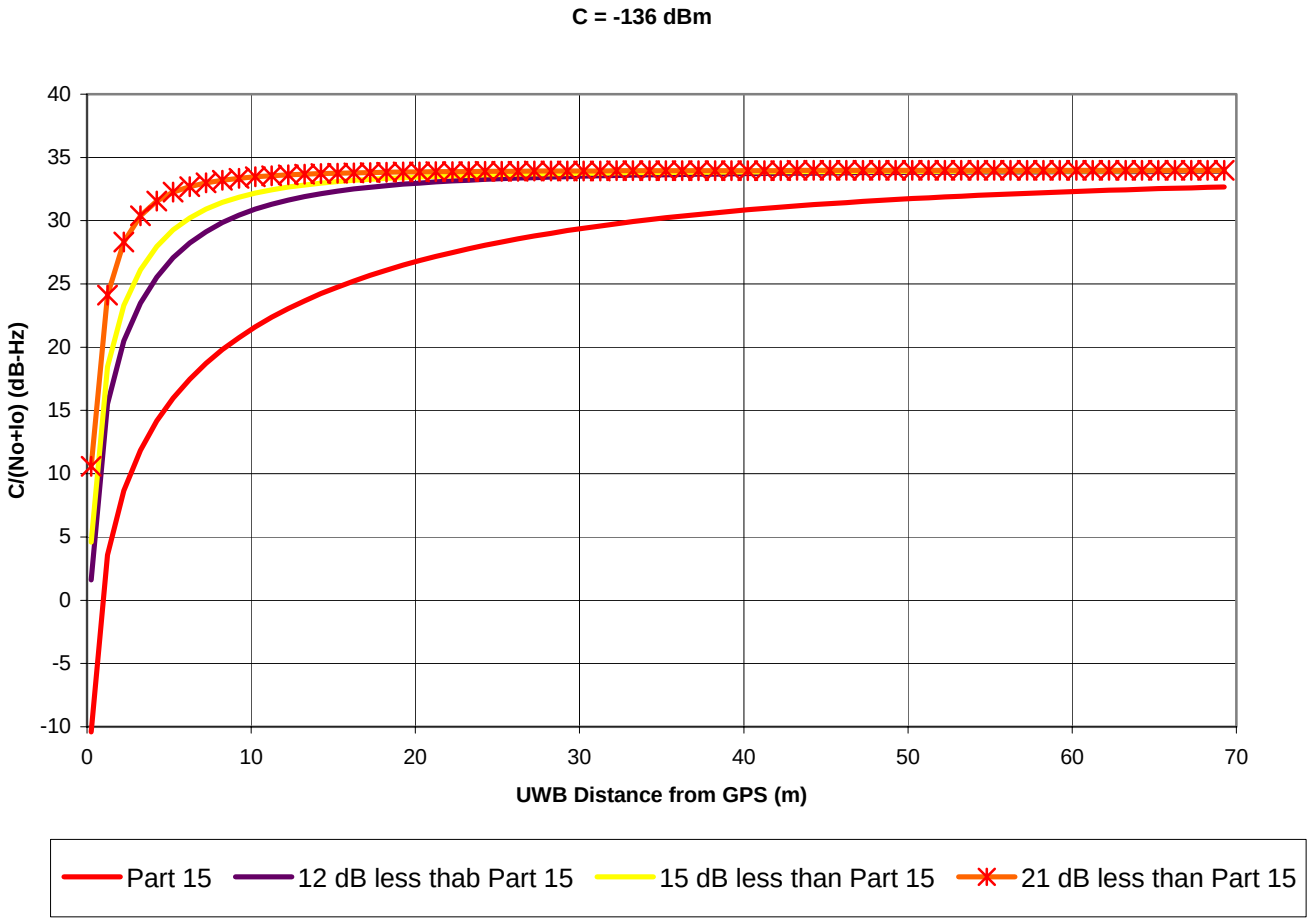

Figure 4:C/(No+Io) for indoor environment under strong signal conditions

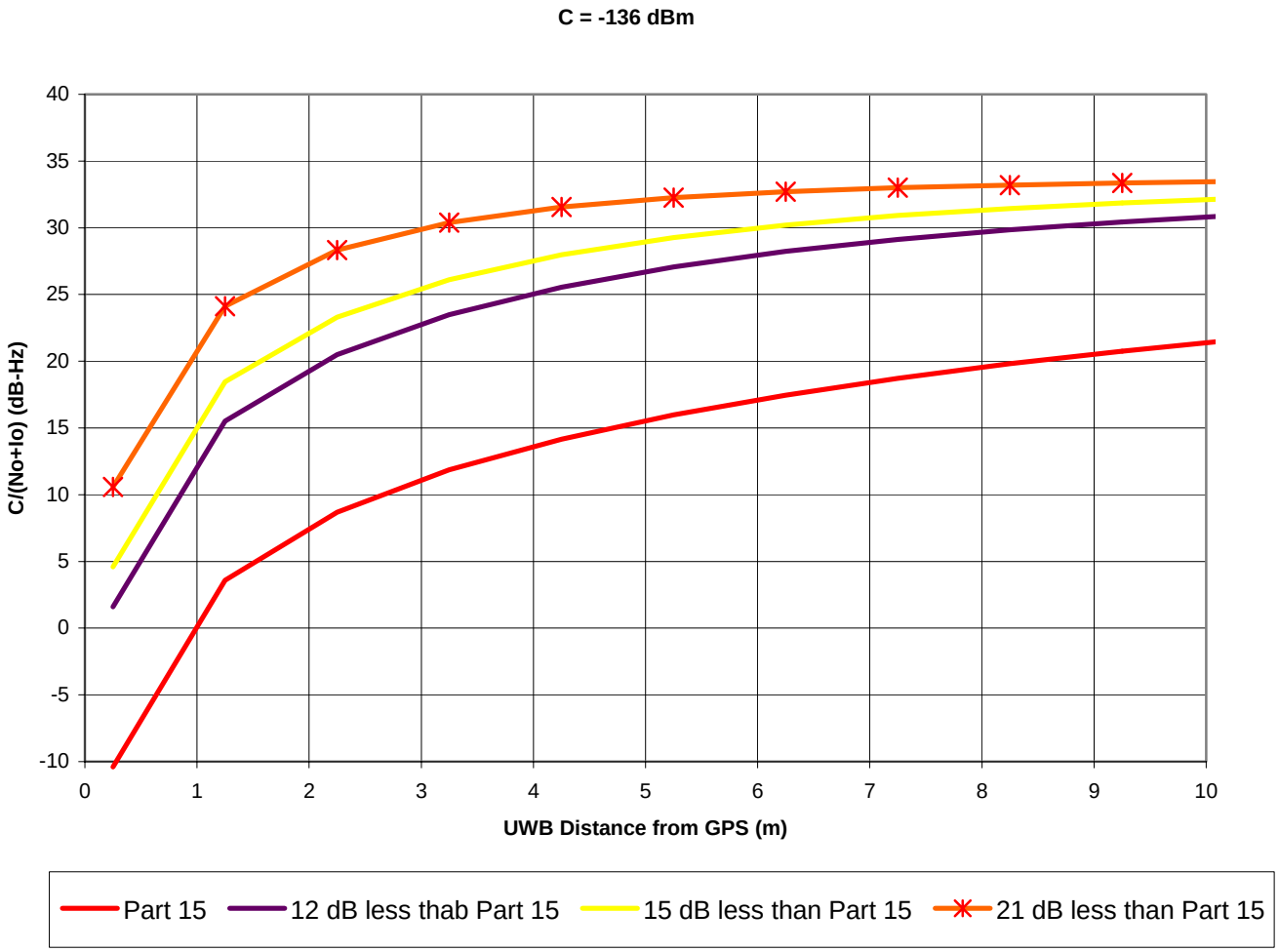

Figure 5: Zoom-in of Figure 4

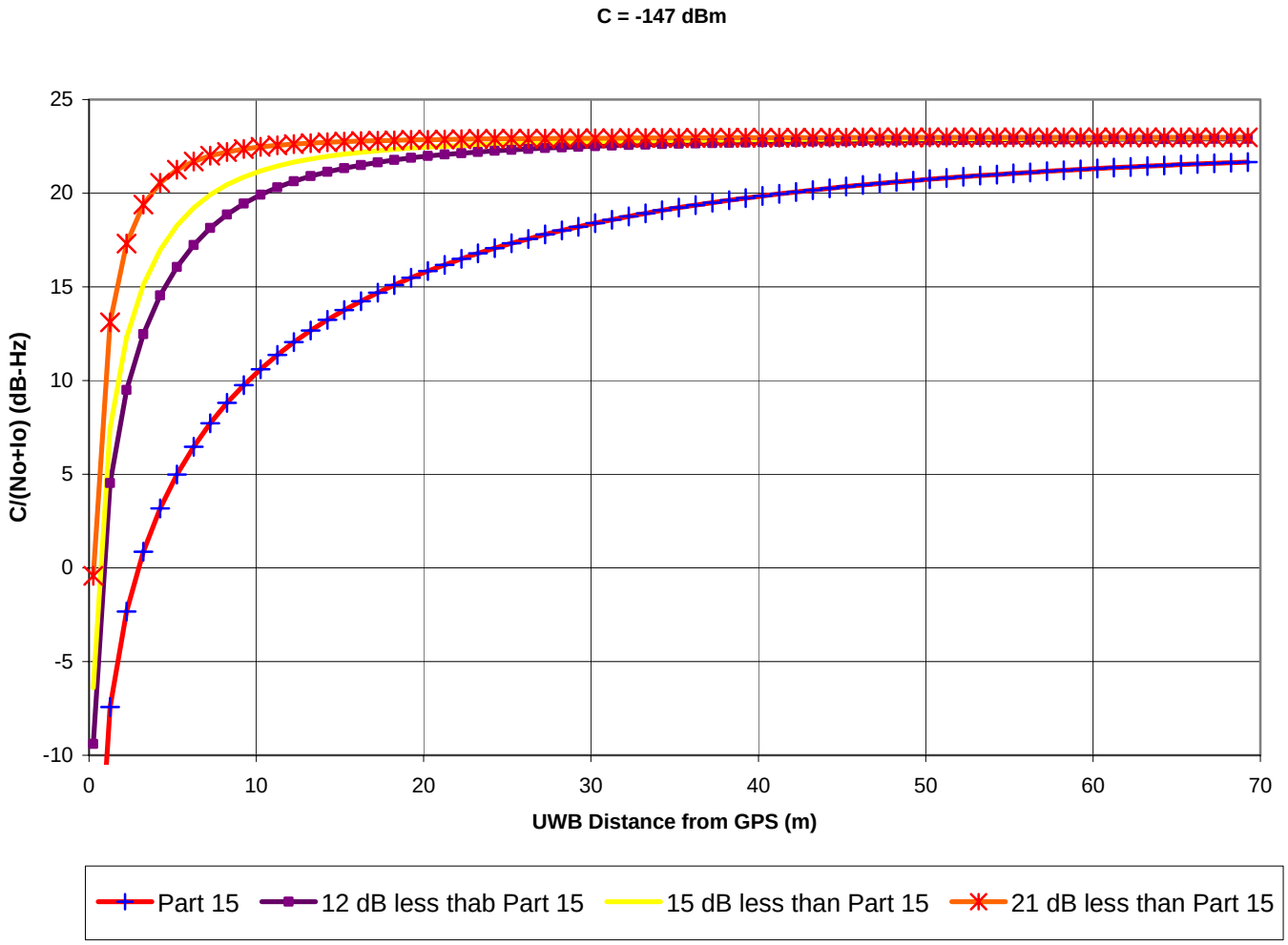

Figure 6: C/(No+Io) at sensitivity level as specified by ballot version of IS-916

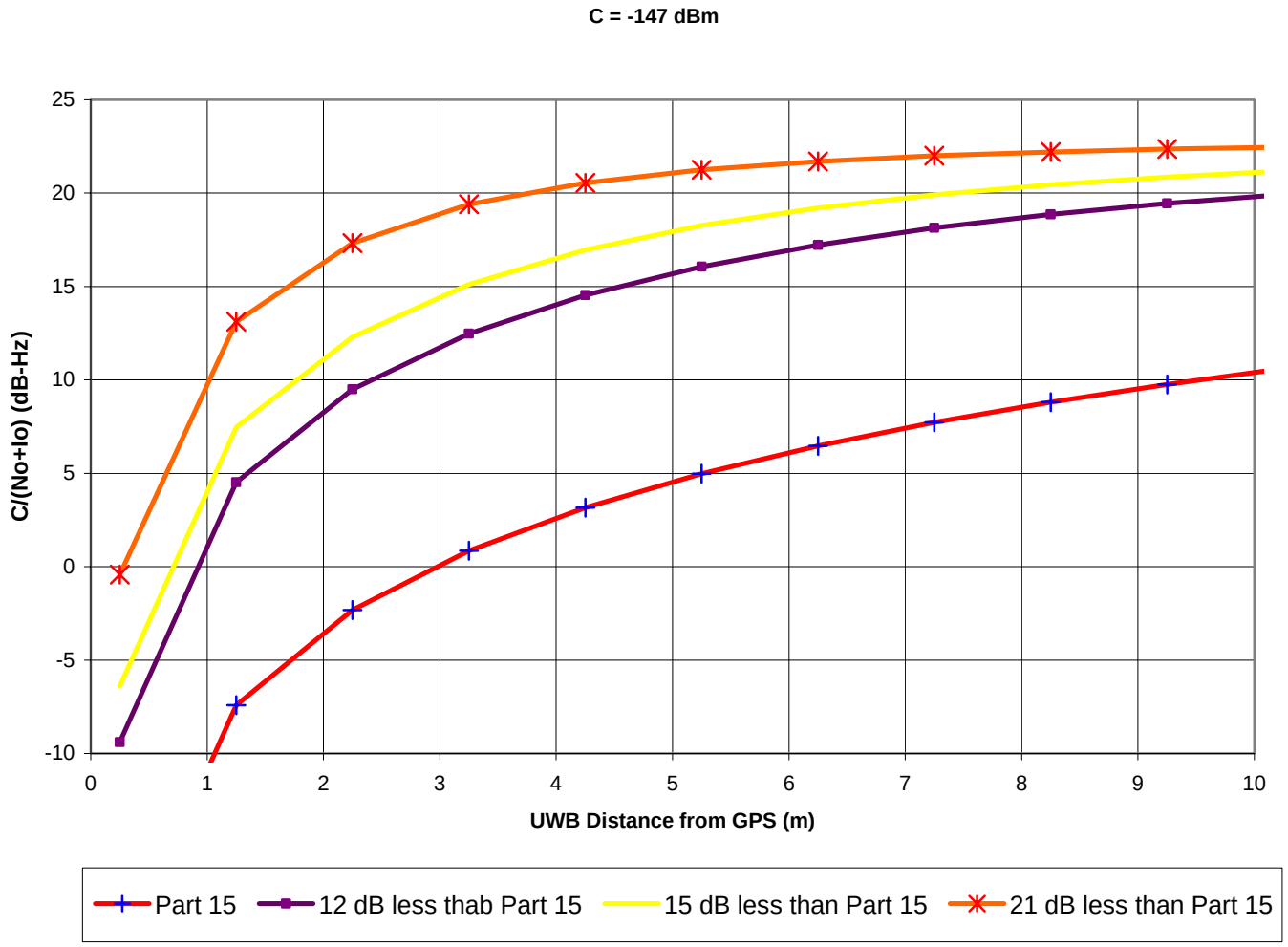

Figure 7: Zoom-in of Figure 6

3. Conclusion

For the foregoing reasons, QUALCOMM respectfully submits that the Commission should entirely disregard the claims of XtremeSpectrum. QUALCOMM's test did prove that a single UWB device will cause significant harmful interference to a E911 phone using gpsOne. Such interference cannot be mitigated unless UWB emissions are limited to 35 dB below the current Part 15 Class B level across the cellular, PCS, and GPS bands.